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Improved Terahertz Radiation from Schottky Contact on Porous Silicon

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Introduction Conventional metals and semiconductors are proposed as potential terahertz (THz) emitters. It has been reported that nanocrystallization of these conventional materials can give them surprising THz emission abilities. In this study, we report that THz radiation from Schottky electric field at the interface of a thin semiconductor (copper oxides) and metal (gold) film was reinforced by a porous silicon (PSi) substrate comparing with a planar silicon substrate.

Experimental methods A porous silicon substrate was obtained by an electrochemical method. Metal depositions on porous silicon substrate were prepared by a magnetron sputtering process. Sputtering target metals are gold (bottom layer) and copper (upper layer) and the prepared Cu/Au/porous silicon composite material was placed in ambient air to oxidize copper layer for at least 1 month. THz emission spectra were recorded by typical THz pump detection system.

Results and Discussions Figure 1 shows THz emission spectra of the obtained samples. A remarkable peak appeared in the THz emission spectrum of the porous silicon sample (red line) is about 4 times higher than that in planar silicon. Since the THz emission arises from the interface Schottky electric field between gold copper alloy and copper oxides (a kind of p-semiconductor), the oxidation degree of the copper layer is a factor to determine the efficiency of THz emission. On the other hand, surface Plasmon can be excited by an incident light due to the surface porous grating structure which can strengthen the built-in electric field induced by Schottky contact at the interface. Because the wave number of surface Plasmon is always higher than that of the incident light, so the planar substrate can not excite surface Plasmon. However, this surface grating structure of the porous silicon can give the extra wave number by its periodic morphology that matches the surface Plasmon resonance condition. As a result, due to the porous grating morphology, an enhanced THz emission was observed in copper oxides/Au/porous silicon sample.

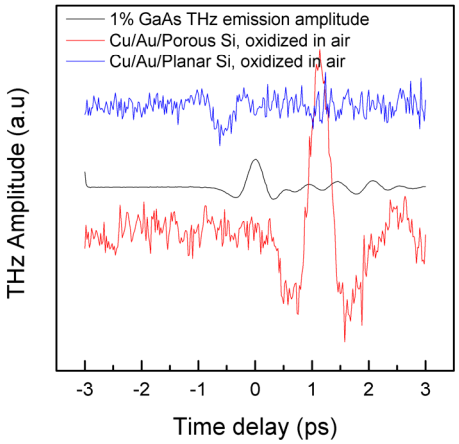

Fig. 1 THz spectra of different obtained samples

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